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ABSTRACT

This book provides an overview of current applications of technology in education; it is organized in eight chapters covering the following trends. (1) There is near saturation of computers in K-12 schools, while higher education institutions report moderate saturation. Students and teachers have almost universal access to computers, many of which are connected to the Internet. (2) The Internet has become a major source of information for students and teachers. In higher education, the use of the Internet to deliver instruction has been steadily growing. (3) Video materials are increasingly being delivered by a variety of distribution systems, such as video streaming on the Web, video conferencing, synchronous teaching and learning by closed circuit, broadcast and satellite television systems. Use of video in classrooms and independent study spaces has leveled off. (4) More community organizations than ever are promoting and supporting the use of technology for teaching and learning in schools, colleges and the public sector. Policy organizations have joined the chorus of voices that advocate more and better use of technology in schools and higher education. (5) The home has become a classroom for children and adults. Distance education has become a significant provider of instruction through the use of technological media. (6) New delivery systems have stimulated the development and use of technological applications for teaching and learning. Foremost among them are wireless devices, such as laptop and handheld computers. (7) Opportunities for teachers to become competent in the use of technology for teaching and learning have increased substantially, resulting in greater and improved use in education. (8) More than ever, reputable organizations perceive the use of instructional technology in schools, colleges, and the public sector as a vehicle for education reform. (Contains 61 references.) (MES)

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Trends in Educational Technology

Donald P. Ely

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FIFTH EDITION

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Donald P. Ely is Professor Emeritus, Instructional Design, Development and Evaluation and Founding Director of the ERIC Clearinghouse on Information & Technology at Syracuse University. He is the author of *Trends in Educational Technology* published in 1988, 1989, 1992 and 1996. He currently is Visiting Professor, Instructional Systems Design, at Florida State University. During the writing of this edition of *Trends* he was a Visiting Professor of Instructional Technology and Distance Education at Nova Southeastern University. His most recent book is the *International Encyclopedia of Educational Technology, Second Edition,* which he edited with Tjeerd Plomp from the University of Twente in the Netherlands.

Preface

THIS MONOGRAPH is fifth in a series about emerging trends in the field of educational technology. Earlier editions, published in 1988, 1989, 1992 and 1996, were also published by the ERIC Clearinghouse on Information and Technology. Trends do not emerge full-blown from year-to-year but usually begin with indicators from the past and generally strengthen (or fade) in subsequent years. From time to time, new trends appear. Trends are considered to be snapshots taken at one point in time, thus reflecting the current status. Identifying trends is not an exact science.

Trends derived from the 1996 edition were used as building blocks for this edition. (For purposes of comparison, each 1996 trend is listed next to the related, current trend in the appendix.) The possibility that those trends could be either weakening or strengthening was considered, as was the possibility that new trends could be emerging.

Sixty-four doctoral candidates at Nova Southeastern University were enrolled in the course entitled Trends and Issues in Instructional Technology and Distance Education during the summer 2001 term. They were given an assignment to select one of the trends from the 1996 publication and to update it. In addition, they were asked to nominate new trends for inclusion in the current volume based on a comprehensive review of the literature.

These budding researchers were instructed to focus their efforts on quantitative information. Instructions to the researchers and analysts were to give priority to information based on data; to use opinions from ac-

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knowledged authorities only; to look for indicators that trends are weakening as well as strengthening; and, when several indicators show a tendency toward a new trend, to try to confirm them with other sources. (Isolated facts and opinions are not sufficient to establish a trend.)

Many of the sources used were based on data. Studies from recognized nationwide studies were used, such as those conducted by the National Center for Educational Statistics, the United States Census, Quality Educational Data, the Campus Computing Project, and the Pew Research Center.

The sources, listed in the References section of this publication, cover more than the quantitative aspect of trends. Widely respected sources were used, such as Resolutions of the National Education Association, a report of the CEO Forum on Education and Technology (2001), a comprehensive list of doctoral dissertation research in educational technology, and *The Changing Faces of Virtual Education*, published by the Commonwealth of Learning (2001) in Canada.

Alert colleagues found useful information in daily newspapers, World Wide Web sites, and daily online technology briefing services such as *Syllabus*, *Edupage* and *Distance Education Report*.

Some of the information being sought was not in the public domain. Marketing services, corporate R & D centers and commercial organizations are reluctant to divulge their proprietary information. Press releases sometimes provided indicators of things to come and new products about to enter the market. These sources were also used when available.

Previous studies on trends by the author reviewed documents and journal articles in the Educational Resources Information Center (ERIC) database in the fields of education and information technology. This source was used again for this fifth edition. The author did a cursory review of the periodical literature as an added measure. Whenever a new trend was proposed, at least three consistent opinions and/or studies were sought before considering it further.

One additional responsible source is the trends review by Molenda

and Sullivan (2002). In "Issues and Trends in Instructional Technology," the authors organize their review into three categories: (1) corporate training and development, (2) higher education, and (3) K–12 education. This organization is especially helpful when seeking information about trends that are specific to those environments. This targeted article is an accurate review of trends in the three specific settings. General trends, as they are presented in this monograph, are not always found in all settings. The Molenda and Sullivan article, unpublished papers from a variety of sources, and analyses prepared by graduate students for use by the author, were used in the final selection of trends for this volume.

This monograph was written for individuals who are engaged in K–12 education, community colleges and universities, business and industry, health professions, military and government settings. Typical users would be instructional designers, technology-based support staff and teachers and/or trainers. Others in administrative or management positions would also be potential readers. Related users would be pre-service or in-service teachers and teacher educators, curriculum specialists, evaluators, librarians, school library-media specialists and commercial business personnel who supply and support education and training activities.

Acknowledgments

GRADUATE STUDENTS in the Instructional Design, Development and Evaluation program at Syracuse University were research assistants for the content analysis phase of earlier editions. For this edition, third-year doctoral students in the Instructional Technology and Distance Education Doctor of Education program at Nova Southeastern University worked with the author. These doctoral students are mature adults who have been active in the doctoral program since 1999. Almost all are employed in a variety of settings in the United States and Jamaica. For example, the group included college and university instructors, public and private school teachers, business and industry employees, government (NASA) workers, military personnel and employees of religious organizations.

The following individuals contributed to this fifth edition: Susan Amirian, Sandra Atols, Lee Ayer-Palpant, Kim A. Baker, Melvin B. Baker, Ramona Becker, Regina Blue, Kathy Burgis, Joan Burtner, Burnett Burton, Theresa Calderone, Terry Daniels, Scott DeClue, Susan Devaney, Dick Eigenraam, Sheila Ellenberger, Fredrika Fairclough, Dulcie Fisher, Jerree Forbes, Robert Gibson, Catherine Gmoser, Betty Graham, Lydia Grapine, Kristin Hill, Janice Hilyard, Jonathan Hochberg, Diane R. Johnson, Linda G. Johnson, Leah D. Jones, David Kluth, and Patricia Knox.

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I would like to thank each one.

Trends in Educational Technology

Introduction

THE OVERALL FOCUS of this new edition is on current applications of technology in education settings. Trends are rarely specific reports on "the truth"; at best they are indicators of direction. Trends do not necessarily predict the future; they are more likely to report current status that developed over time. This monograph is an attempt to identify current trends in educational technology. As such, it provides a platform for discussion of issues facing the field and serves as a launching pad for future studies. This is a moment in history, a photograph of "what is" that can serve a purpose in a field that is still relatively new and experiencing rapid growth.

The *Merriam-Webster's Collegiate Dictionary* (2001) defines *trend* as "a line of general direction or movement" and "a prevailing tendency or inclination." Further, it is "the general movement in the course of time of a statistically detectable change" (p. 1255). These definitions express the intent of this publication. A simpler question might be, "What is happening today in the field of educational technology and training?" Trends help us to see where we are headed. They sometimes point the way for making decisions. They often confirm or reject hypotheses that are formulated by individuals who are about to make decisions. They also help to define a field by determining who and what is "in" and who and what is "out" of a field's current scope.

The official definition of educational (or instructional) technology, adopted by the Association for Educational Communications and Technology (AECT), is "the theory and practice of design, development, uti-

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lization, management and evaluation of processes and resources for learning" (Seels and Richey 1994). There is an alternate definition in *To Improve Learning* (Commission on Instructional Technology 1970) that explains instructional technology and instructional design in a more descriptive manner: "Instructional technology is more than the sum of its parts. It is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction" (p. 21).

It is tempting these days to define educational or instructional technology in terms of computer applications and use of the Internet, vehicles frequently used for teaching and learning. However, the more inclusive definitions above describe a spectrum of resources and processes that are often used in education and training. This broader systemic scope has guided the research for this monograph.

The trends presented in this monograph are based on a broad analysis of educational technology developments since 1996. The overview encompasses most education institutions in America. The trends for specific education levels or settings, for example, K–12 schools, higher education and vocational training, can be derived from the general statements of trends.

The current trends have been based on previous trend studies beginning in 1987. The continuity of the studies over the years helps to increase confidence in the current list. Trends usually reflect an ongoing analysis of direction.

In quiet ways, technology has entered the classroom with increasing intensity since the previous edition of this monograph was published in 1996. The pace of educational technology development is continuing to quicken as new equipment and applications are employed. The presence of these potentially powerful tools in classrooms continues to encourage inquiry into the nature of learning and ways in which instructors can bet-

ter assist their students. Beyond the use of technology in the traditional classroom, computers and the Internet have opened educational opportunities through distance education. For adults and some housebound learners, instruction is brought to the home for use at any time.

Computers and the Internet currently dominate educational technology. In fact, the term *online learning* is often (inappropriately) used as an equivalent to educational technology. The significant growth in distance education has been fostered by improved access to computers and the Internet in nearly all environments where formal teaching and learning occur. At the same time, the use of instructional television, which dominated educational technology four decades ago, has leveled off.

With the increasing availability of networked computers in the home, school and office, as well as throughout the community, more people are using these tools than ever before. Access to information, formal courses and other resources is no longer a major problem for most citizens, regardless of their location, economic status or level of education. One exception to universal access is the "digital divide" that exists between those who have computer access and those who do not. Wireless handheld devices and laptop computers have supplemented wired access. The wireless devices are usually extensions of the basic functions of tabletop computers in the home, office and classroom. Many institutions look forward to financial savings when wired connections are no longer required.

Advocacy for the use of technology in education is increasing. For some, such advocacy calls for large-scale reform in both K–12 schools and higher education.

Professional education associations that have been reluctant to endorse the use of technology in teaching and learning in the past are beginning to support innovative moves in this direction. For example, the American Federation of Teachers (AFT), the National Education Association (NEA) and the American Association of University Professors (AAUP) are moving from modest endorsement to public advocacy.

The pressure to use technology in education by parents and govern-

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ment agencies—coupled with state, federal, and business funding—has focused on technology as a significant vehicle to education reform. Many teachers who had shunned technology because they lacked knowledge and skills to introduce new approaches in the classroom are now taking advantage of new training opportunities. Some states and school systems are providing various incentives, including financial ones, to teachers who attain and use these skills in the classroom.

While, in the minds of many advocates, educational technology provides a vision of education reform with technology as a major vehicle, this vision may be misdirected when technology dominates learning and pedagogical processes are secondary. When technology is used as a vehicle and is combined with procedures that insure compelling learner engagement, the reform of teaching and learning will occur. One primary role of technology is to motivate and lead learners to new ways of problem-solving and independent thinking. The potential for collaboration among learners is an added feature, one that blends technology protocols with human interaction among people seeking common educational goals. Such collaboration provides the means for social interaction that is sometimes thought to be absent from independent and isolated use of computers.

Only time will determine the extent of adoption and implementation of the technological innovations after outside funding has diminished or disappeared. The ultimate evaluation will be the extent to which learners have achieved curriculum goals and objectives. Measures of cost/effectiveness will also help to inform future commitments to technology for teaching and learning.

While it would be irresponsible to imply that technology is *the* major vehicle leading to education reform, it must be credited with contributing to the movement in both schools and universities. New vehicles and new approaches to learning create signs of change. Technology is not the only element in the change process, but it is being embraced as an important part of the systemic entity called education.

CHAPTER ONE

Computer Access and Use

TREND 1: *There is near saturation of computers in K–12 schools, while higher education institutions report moderate saturation. Students and teachers have almost universal access to computers, many of which are connected to the Internet.*

FOR K–12 SCHOOLS, the measure is usually stated in the number of students per computer. The number of computers in elementary and secondary schools in America has been steadily increasing from one computer for every 125 students in 1983–84 and then one computer for every 50 students in 1985–86 (Ely 1988) to one computer for every 6.6 students in 2000 (Market Data Retrieval 2001). In a survey of the 250 public school districts that control 33% of all spending in the United States, the average low figure is 3.84 students per computer and the average high is 19.74 per computer (Quality Education Data 2001). In this survey, the lowest district figure was 3.1 and highest was 25.3.

One caution in interpreting these figures as actual assignment of students to a single computer is that the figures usually represent *access* to a computer. The computer is usually shared in the classroom or laboratory. The ratio provides a relative approximation of the extent of computer availability in any given school or district. It is obvious from the data that computer access is nearing a point of saturation. These figures do not include home use of computers.

Further confirmation of the saturation comes from a 1999 study of the National Center for Educational Statistics, *Teachers' Tools for the Twenty-First Century*. The study reports that, "Nearly all public school teachers (99 percent) reported having computers available somewhere in their school in 1999." Further, "84 percent had computers available in their classrooms, and 95 percent had computers available elsewhere in the school" (p. ii).

As for actual use of computers in schools, half of the teachers who had computers in their schools used them for classroom instruction. Teachers had students use them for word processing or creating spreadsheets most of the time (61%), yet they were also used for Internet research (51%), practicing drills (50%), and solving problems and analyzing data (50%). In addition, teachers used computers for creating instructional materials, gathering information for lesson plans, and communicating with colleagues (National Center for Educational Statistics 2000b).

Reports regarding computer use in schools frequently include Internet applications such as e-mail correspondence and use of the World Wide Web. It is often difficult to separate the computer applications from the computer itself. The computer is a vehicle for delivering many options. It is the software that determines the nature of use. (Internet applications in education settings are discussed in chapter 2.)

In the higher education sector, one of the most reliable studies of technology use is the annual Campus Computing Project, begun in 1990 by K.C. Green of Claremont Graduate University in California. The 2001 report provides data about the growth of computer applications in colleges and universities. For example, 64% of all four-year colleges and universities use instructional software and 67% offer online courses. (Online course registration is up from 21% in 1998 and 43% in 2000.) Previous studies by Green show that saturation has not yet been reached in higher education as it has in the K–12 schools. However, computer purchases for instruction in colleges and universities are leveling off as financial resources become more limited. Budget cuts across all sectors of higher edu-

cation provide clear indicators of declining technology spending during 2001. About 18% of the 590 institutions participating in the 2001 study reported a decline in the budget for campus computing during that year as compared with 11.4% in the 2000 survey. A growing number of institutions identified course management systems as "very important in their institutional planning" (Green 2001, p. 3). About three quarters of the institutions have adopted a uniform course management system for use in all online courses. In 2000, about 58% of the institutions said that they use common templates, such as Blackboard, WebCT, First Class and Campus Pipeline (Green 2001).

Ownership of computers by college students is another finding that deserves to be mentioned here. The 2001 survey data indicate that the proportion of students to computers is rising to almost three-fourths (71.5%) of all students in 2001, compared with 58.6% in 2000 (Green 2001). Most computers owned by students in 2001 were desktop (55.7%), while notebook (laptop) computers were owned by 15.8%. The increasing availability of wireless services (11% of institutions) offers some motivation to purchase and use notebook computers (Green 2001).

The computer has become a symbol of educational (or instructional) technology. There appears to be a prevailing assumption that computers are accepted as equivalent to educational technology. For example, the 1999 NCES study, mentioned earlier, is about use of the computer and the Internet in the schools. The subtitle of the publication is "A Report on Teachers' Use of Technology." Another study, *The 2000 National Survey of Information Technology in United States Higher Education* (Green 2000), reports quantitative data about the use of computers and the Internet in U.S. colleges and universities. A recent "state-of-the-states" study on K–12 classroom use of technology in *T.H.E. Journal* is focused on computer integration, percentage of computers in each state by manufacturer, classroom Internet access and funding sources (Roberts 2001).

Focusing on the computer and its applications confirms the dominant role it has attained and continues to make in schools and post-secondary

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institutions. It is unfortunate that other elements of the instructional technology process, such as design and evaluation, are omitted or de-emphasized when such a one-sided view is presented. The author of this new edition attempts to present a more comprehensive view of technology in education by including discussions of such trends as technology literacy for teachers and the growth of distance education.

CHAPTER TWO

Internet Access and Use

TREND 2: *The Internet has become a major source of information for students and teachers. In higher education, the use of the Internet to deliver instruction has been steadily growing.*

IT IS THE CONVERGENCE of personal computers, networks and the World Wide Web into networked, multimedia communication and information systems that makes this trend so powerful. While the technology is impressive and often mind-boggling, the mere presence of a networked multimedia Internet-connected system does not guarantee its effective use. The task of educational technologists is to focus their efforts on integrating the newly available electronic technologies into existing teaching and learning environments that incorporate sound principles of teaching and learning while continuing use of earlier technologies.

Networking describes a multiplicity of Internet activities for a variety of purposes: commerce, hobbies, personal correspondence, research and education. More than thirty million children, or 73% of youth ages 12 to 17, have Internet access at school or home (Pew Internet and American Life Project 2001). Networked information connects students with vast and growing resources that enable them to connect with other students, experts, and their instructors by using e-mail, threaded discussions, and other communication modes. The use of online tools and resources has also brought about the rapid growth of distance learning for more learners, at all levels.

The front page of *USA Today*, 6 September 2001, carries a graph with the headline, "Internet Access Booms in Schools." It shows the percentage of K–12 schools with Internet access. There is a rising slope from 30% of elementary schools having access in 1994 to 97% in 2000. Secondary schools' access increases from 49% in 1994 to 99.7% in 2000. The figures are quoted from a National Center for Educational Statistics study (2001). As in many such studies, there is a margin of error. But even with the interpretation of error, the fact is that there is almost universal Internet access in America's schools. A further confirmation comes from a study by Quality Education Data (2001) that reports 49% Internet access in all U.S. public schools in 1996 and 97% in 2001.

Access is the beginning of Internet use, but it is fair to ask, "To what end?" Research conducted by the Pew Internet and American Life project (Pew 2001) indicated that 94% of secondary school youth who have Internet access say they use it for school research. Seventy-one percent say they used the Internet as the major source for their most recent school project or report and 58% report using Web sites that have been set up specifically for their school or for a particular class.

Quality Education Data (2001) numbers indicate that teachers' use of the Internet is growing and becoming more sophisticated (see Table 1).

Table 1

A Comparison of Internet Use by Teachers in 1999 and 2000

Types of Use	*Percentage of Teachers*	
	1999	*2000*
Evaluating curriculum material	63.0	80.8
Research	74	78.7
E-mail/communication	82	72.7
Professional development	55	53.2
Presentation tool	43	52.9
Lesson planning	57	52

In higher (post-secondary) education, the Campus Computing Project (Green 1999) reports that all respondents to the 1999 survey indicated that networks were the most important aspect of the information technology infrastructure. It is unlikely that this conclusion has changed with the ubiquitous presence of the Internet and local data networks in schools and colleges. The 2000 study revealed that 59.3% of all college courses use e-mail and 42.7% (up from 10.9% in 1995) use World Wide Web resources. Faculty members at institutions of higher education have usually been late adopters of innovations for teaching and learning. Yet almost 25% had a personal Web page in 2000, and courses using Web pages increased from 9.2% in 1996 to 28.1% four years later (Green 2000).

After the explosive growth of the Internet in colleges and universities during the late 1990s and early twenty-first century, there is some evidence that Internet-based instruction is slowing to a peak of about 45% of faculty use (Molenda and Sullivan 2001). Note that slowing is in the area of *instruction* and does not include research, management and personal communications.

Traditional approaches to teaching and learning in post-secondary environments continue to be a dominant force for a number of reasons. Professors hesitate to change. Some instructors do not have the skills to use information technology and are not especially eager to learn. There is an institutional reluctance to provide sufficient personnel and financial assistance to facilitate the use of networking in many institutions. Molenda and Sullivan (2001) report that many institutions are struggling to pay for their information infrastructure, especially with the increasing demands for wireless access and problems retaining technical staff.

Steven Gilbert, who heads the Teaching, Learning and Technology (TLT) group at the American Association for Higher Education has monitored new technological developments in college teaching for more than a decade. He says, "the calls for a major shift toward 'learner-center education' increased, with emphasis on individualization, independent learning, active learning, authentic teaching, standardization of course content

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and outcomes, [and] 'scalable' new programs" (Gilbert 2001, p. 28). There is not much reliable data on current developments in this area, but increasing mention of these new approaches to learning in colleges and universities are found in professional journals and in the many workshops and seminars for instructional staff. The recognition of new approaches to teaching and learning seem to indicate that these are trends in the making. Centers for the support of teaching and learning are growing on many campuses and provide a stimulus for change by removing some of the barriers to change, especially by providing assistance with technology applications. A report on these technology centers states that 66% of colleges and universities currently have such centers (Green 1999).

CHAPTER THREE

Television and Video

TREND 3: *Video materials are increasingly being delivered by a variety of distribution systems, such as video streaming on the Web, video conferencing, synchronous teaching and learning by closed circuit, broadcast and satellite television systems. Use of video in the classroom and independent study spaces has leveled off.*

THE LEVELING OFF of television use for instruction has probably occurred because of its universal availability in many education settings. To discuss trends in the use of video materials, it is necessary to look at the variety of delivery systems and applications currently being used.

Video streaming, the use of moving audiovisual images, is gaining popularity among sophisticated users of the Web. It is difficult to quantify the use of video streaming because of its idiosyncratic application at the local level. It is included as a video trend because of its increasing appearance on Web sites. The use ranges from basic illustration in support of learning to "window dressing" for visual impact. It is likely to increase as the delivery technology improves.

It is likewise difficult to estimate the extent of *video conferencing* today. Video conferencing includes applications such as synchronous communication between individuals in two or more locations. It is also used in courses delivered synchronously from one studio location to learners in many remote locations. In the latter case, the distribution systems are not

unlike video conferences since a teacher, usually in a studio or classroom, sends instructional messages to students in one or more remote locations and is able to carry on two-way conversations. This is usually a closed circuit television operation. *Broadcast television*, usually available to anyone who wishes to tune in, is extended by subscriber *cable television*. Cable brings programming from both broadcast and local studios to schools and individual subscribers who have television sets in the home or workplace.

The video sources mentioned above are most often synchronous, that is, the viewer watches while the program is presented. However, video recordings can be viewed at any time. There are complete courses available only on videotape. These may be recordings of courses that have been offered via broadcast or cable systems first. These systems are basically one-way; that is, the learner views a videotape independently and rarely interactions with the instructor. Sometimes individual help is provided by telephone or e-mail.

Large-scale producers of television for schools and colleges do offer useful programming. Cable in the Classroom, established by the cable industry in 1989, provides private and public schools with access to educational television programming through free cable connections. Thirty-nine national cable networks and approximately 8,500 local cable companies support the initiative. In August 2000, 81,056 schools had a cable television connection (providing access for 86% of all students in grades K–12), up from 70,754 in 1995. Cable in the Classroom offers over 540 hours of commercial-free, copyright-cleared programming monthly from providers such as the Discovery Channel, the Weather Channel, CNN and the History Channel. Most of the programs are broadcast in the early morning hours. Schools record the programs that can then be used later in the day at a time more convenient for the students and teachers. Teachers' guides are available at no cost (Cable in the Classroom 2001).

In 1997, the Corporation for Public Broadcasting (CPB) conducted a study of television and video usage in U.S. public schools. (The study is the

fourth in a series stretching back to 1976 and uses a stratified random sample of classroom teachers and school principals.) This latest study showed that nearly all teachers (98%) had access to television and video in their schools. All of the educators surveyed said that they had used television or video in their classes within the past five years. Other interesting data in the CPB study showed an increase in the use of video editing equipment and laser disc players. Satellite capabilities doubled between 1991 and 1997. It is likely that there are even more installations today.

Teachers use television in the classroom approximately 88 minutes per week (Corporation for Public Television 1997). Public television resources count for 27 minutes and cable sources for 13 minutes. The other 48 minutes provide a variety of local and national television resources that are available to schools.

The use of television in the classroom has not reduced the use of computers. The CPB study noted that teachers who have both computer and television (and video) capabilities in their classroom use both of them. About one-quarter of the teachers reported that their use of television and video had actually increased with the availability of computers.

The trend for instructional television seems to be stable near saturation with a few modifications in the delivery systems. Innovations are found in new uses and emerging collaborations. Partnerships between public television and educational institutions at all levels are on the rise (Fellows and Connet 2001). "Public television stations are linking television to WWW sites and allowing users to move between the two media to find desired information" (Fellows and Connet 2001, p. 39). New digital technologies offer further opportunities for cooperative ventures between education and public broadcasting.

Television is an active player in the world of distance education. A study of the National Center for Educational Statistics (1999) revealed that the media most frequently used are: asynchronous Web sites (58%), interactive video (54%), and prerecorded video (54%). These media were

used either as the single delivery mode or in combination as a hybrid approach. There appears to be a trend away from one mode of delivery, such as television, to a hybrid approach in which several media are used as appropriate. Not only is this approach more effective, but it also appears to reduce the students' boredom.

CHAPTER FOUR

Advocacy

TREND 4: *More community organizations than ever are promoting and supporting the use of technology for teaching and learning in schools, colleges and the public sector. Policy organizations have joined the chorus of voices that advocate more and better use of technology in schools and higher education.*

SUPPORT FOR EDUCATIONAL TECHNOLOGY is expected from those who are practitioners in school and college settings and also from suppliers of hardware and software. When increasing support comes from outside the education environment, it appears to become a more legitimate movement. Such support was not forthcoming in the early days of the audiovisual movement that preceded the introduction of digital resources, later defined as "educational technology" innovations. The last decade has seen increasing support for educational technology from organizations and associations that are not in the mainline of the movement.

At the federal level, when the Executive and Legislative branches of government change after elections, the priorities also change. One notable report is a national educational technology plan entitled *eLearning: Putting a World-Class Education at the Fingertips of All Children* (U.S. Department of Education 2000). The 18-month study—which involved educators, administrators, policy makers and the private sector—provided a new national strategy for effective use of technology in elementary and

secondary schools. The five goals in that report offer a useful roadmap for the field, even though adoption and implementation of the goals may be modified or curtailed.

1. All students and teachers will have access to information technology in their classrooms, schools, communities and homes.

2. All teachers will use technology effectively to help students achieve high academic standards.

3. All students will have technology and information literacy skills.

4. Research and evaluation will improve the next generation of technology applications for teaching and learning.

5. Digital content and networked applications will transform teaching and learning.

At the same time, the Web-based Education Commission (2000) released its final report entitled, *The Power of the Internet for Learning: Moving from Promise to Practice*. The report recommends: making new Internet resources widely and equitably available and affordable for all learners; developing high-quality online educational content that meets the highest standards of educational excellence; and revising outdated regulations that impede innovation and replace them with approaches that embrace anytime, anywhere, any-pace learning.

One other report from the U.S. Department of Education (2001) highlights national data and state profiles that show funding for educational technology totals more than eight billion dollars since 1995. Entitled *Progress Report on Educational Technology*, the report illustrates state-by-state federal investments in educational technology from 1995 to 2000. It confirms increasing activity in the area of educational technology on the national scene. All of these publications can be ordered (and some downloaded) from the U.S. Department of Education Web site (www.ed.gov/technology).

The momentum of support began in a major way with the publications of the National Governors' Association. Its annual reports on education began in 1986. Since the end of these annual reports in 1990, individual

governors have moved ahead with new technology applications for education. For example, the proposed Maine Learning Technology Endowment has been studied and now rests with the legislature. Michigan governor, John Engler, has asked for $110 million to equip all 90,000 public school teachers with laptop computers. Time will tell whether these programs will be funded. The fact that they have been proposed at all confirms the need for implementing digital tools in much the same way that instructional television has been adopted statewide in Kentucky and South Carolina. The Western Governors' University, now in its fifth year of operation, is a technology-based virtual university with over 1,000 courses available from participating colleges and universities. Forty higher education institutions from 22 states are partners in the program (Miller 2001).

Another area of support for technology in education comes from the business and industry sector. Employers of secondary and post-secondary graduates and commercial organizations have stepped up their advocacy for technology training. The CEO Forum on Education and Technology released its final report in 2001. It is the culmination and synthesis of four years of research into the impact of technology in education. The subtitle, *Key Building Blocks for Student Achievement in the Twenty-First Century*, gives further insight into the nature of this comprehensive report. The Forum consisted of key executives from sixteen companies deeply involved in technology-related businesses and three executives from educational organizations. The Forum's key recommendations are as follows:

1. Focus education technology investment on specific educational objectives.

2. Make the development of twenty-first century skills a key educational goal.

3. Align student assessment with educational objectives and include twenty-first century skills.

4. Adopt continuous improvement strategies to measure progress and adjust accordingly.

5. Increase investment in research and development and dissemination.

6. Ensure equitable access to technology for all students. (CEO Forum on Education and Technology 2001)

Other influential groups are found in national government agencies and in national professional education associations. The President's Information Technology Advisory Committee (PITAC) report, *Using Information Technology to Transform the Way We Learn* (2001), lays out a set of recommendations that support the transformation of education at all levels while addressing key elements of the education process: tools, systems, processes, learners, and teachers. Their overarching recommendation is to "make the effective integration of information technology with education and training a national priority." More specifically, they offer a list of support actions:

1. Establish and coordinate a major research initiative focusing on learning technologies and sciences, information technologies for education and training, and requirements for learning and teaching information technology fluency.

2. Establish partnerships involving government, university, industry, and foundations to support the pursuit of the research initiative and to co-fund and collaborate in that research.

3. Enable educators and related professionals to use information technology effectively.

4. Work with industry and academia to develop technical standards for extendable component-based technology and infrastructures that can be widely used in education and training. (Boettcher 2001, p. 17)

Judith Boettcher makes a keen analysis of the PITAC report. She probes the questions that would have to be raised to begin implementation of the recommendations. She rightly points out that the process is evolutionary and requires specific identification of "the research and programs that will speed the development of cost-effective and engaging educational experiences for our teachers and students" (Boettcher 2001, p. 16).

Some of the most vocal commentaries on technology in education are made in reports of the two national teacher organizations: the American Federation of Teachers and the National Education Association.

The American Federation of Teachers (2001) developed *Distance Education: Guidelines for Good Practice*, a report prepared by AFT's Higher Education Program and Policy Council. It focuses on "nearly all the interactions between teacher and student (that) take place electronically . . . audio, video, e-mail, chat, teleconferencing, and increasingly, the Internet" (American Federation of Teachers 2001, 1). The study emphasizes standards and flexibility. AFT believes that every faculty union should become deeply involved in technology decision-making, especially in matters pertaining to control, use and re-use of course materials. To do so, "faculty must retain academic control" (p. 4).

Enthusiasm for technology applications in distance education is not universal. Teachers' unions raise cautions. In a comprehensive article by Kriger (2001) for the American Federation of Teachers, distance education trends in universities and adult education settings are discussed. A concluding statement addresses the cautions that educators should take in regard to distance education.

> The pace of distance education is accelerating, and it is likely to occupy a growing part of the landscape in higher education. But if the report signals expansion, it also demonstrates *the way distance education is being organized and conducted* may pose serious questions. Much of the distance education . . . whether nonprofit or for-profit, is built on ideas drawn from the corporate sector about consumer focus, product standardization, tight personnel control and cost effectiveness (that is, to maximize course taking while minimizing the "inputs" of faculty and development time). (p. 22)

In 2000, the NEA addressed many of the same issues with emphasis on student learning while at the same time considering faculty concerns

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about distance education. The NEA and AFT jointly sponsored a report on distance education in two-year and four-year colleges, conducted by the Institute for Higher Education Policy (1999), entitled *What's the Difference?* The tone of the study is much more skeptical than later studies of AFT and the NEA. The skepticism centered on effectiveness of distance education compared with traditional higher education. Some concerns were stimulated by the unusually strong advocacy of distance learning by higher education administrators.

Most of NEA's membership comes from the ranks of elementary and secondary public school teachers. However, none of the major resolutions adopted by NEA at its 2001 conference specifically address educational technology. Items related to educational technology are imbedded in resolutions about facilities, the content of teacher preparation programs, and time to teach. Even the major resolution entitled "Media" only relates in its reference to the importance of providing closed captions on visual media for the hearing impaired (National Education Association 2001).

Resolutions from previous years are much more specific about access to technology and its use in the classroom. For example, in 2000, NEA adopted a resolution entitled "Technology in the Educational Process," which called for uniform access to high-quality instructional technology for all educators and their students and the training necessary for educators to make effective use of those resources. The resolution also called for the use of educational technology as a support to instruction delivered by a licensed teacher rather than a replacement for classroom instruction thereby attempting to limit the potential growth of the media in education settings (National Education Association 2000).

The lack of technology-related resolutions in 2001 may reflect the general acceptance by that time of technology in the classroom as an appropriate and valid teaching tool. From the standpoint of equipment access and use (see chapter 1) there is reasonable support from many sectors of education for widespread availability of hardware and software in K–12 classrooms and for access to the Internet.

CHAPTER FIVE

Home Use and Distance Education

TREND 5: *The home has become a classroom for children and adults. Distance education has become a significant provider of instruction through the use of technological media.*

THIS TREND FOCUSES on the location where technology is also often used—in the home. Whether it is children doing homework, youngsters who are participating in home schooling, adults who are taking online courses or seniors who are seeking information about healthcare or retirement on the Internet, most of these activities now take place in a home setting. This section discusses the extent to which young learners are using computers and the Internet at home and the unprecedented growth of distance education for adults, much of it taking place in the home.

Newspaper headlines such as "Kids Boost Home Use of Internet" and "Seniors Becoming Big-time Net Surfers" abound. These two were published in *USA Today* on 25 June 2001 and 7 September 2001, respectively. The U.S. Census Bureau (2001) reports that over half of the 105 million U.S. households own at least one computer and that most of those households are connected to the Internet. This is the first time that the percentage has been over 50% since the Census Bureau began tracking such statistics in 1984. More than four out of five homes with computers use them to go online. In 1997, still less than half of the homes were con-

nected to the Internet. The current report is based on about 50,000 homes queried in August 2000.

Approximately 90% of school age children have access to a computer, whether at school or home or both (U.S. Census Bureau 2001). Homes with school age children are much more likely to have a computer and access to the Internet. At the other end of the spectrum are senior citizens, with only 15% using the Internet. A study by the Pew Internet and American Life Project (2001) determined that 69% of the seniors who have computers use the Internet daily. Approximately 60% of the computer users are men. These users are typically well-educated and financially well-off.

The popularity of home schooling has also brought about an increase in the use of computers in the home. In 2000, about two-thirds (65%) of all children three to 17 years of age lived in households with computers, an increase of 10% since 1998 (U.S. Census Bureau 2001). Seventy-three percent of students in middle and high schools have Internet access at home (Pew Internet and American Life Project 2001). Eighty-six percent of home school families use Internet-connected computers for research and for general information searching (Mayfield 2000). There are increasing numbers of software programs designed specifically for home school learners, many on CD-ROMs. In fact, some evidence indicates that the CD-ROM programs have been better received for instructional purposes at home than online services (Pew Research Center 1995).

The use of computers and the Internet by post-secondary students and adults follows the same growth patterns as that of K–12 schools. A report of the International Data Corporation predicts that approximately 85% of two- and four-year colleges and universities will offer distance education courses in 2002, up from 62% in 1998. For the same time period, student enrollments are projected to increase from just over one-half million to well over two million students (International Data Corporation 1999). Most of the students will be 18 years of age and older.

The rapid growth of distance education has been confirmed by studies since the mid-1990s. The percentage of post-secondary institutions offer-

ing distance learning courses rose from 64% in the fall of 1995 to 79% in 1997–1998 according to the National Center for Educational Statistics (2001). Saba (2001) concludes that distance learning has become mainstream and that 2002 will be a pivotal year for further growth. However, the nature of distance education varies from institution to institution and from one instructor to another. According to Saba, there are two choices: "To adopt a model of distance education and eLearning which is as close as possible to face-to-face instruction, or to unleash the real power of distance education and eLearning" (p. 1). The second choice infers that distance teaching and learning is pedagogically different from conventional classroom approaches.

Distance education for younger learners has come a long way since the early 1970s, when the primary tool for instruction was television. In more recent years, online instruction is used most often, and several states and school districts have even established virtual high schools that are entirely distance-based.

The rapid growth of distance learning probably deserves a trend by itself, but it is listed here because much of the activity takes place in the home. True, some distance learners use networked computers at work, school, or in libraries, but the home appears to be a preferred base for online learning. For those who provide distance education, this means that no additional classrooms have to be built and that many of the usual student support services can be decreased or not offered at all. The convenience of courses at home is attractive because of the "any time, anywhere" characteristic of distance education. A study entitled "Perceived Gratifications of Online Media Service Use Among Potential Users" (Lin 2002) concludes that perceived gratification is a strong predictor of online media service use. Online media service is seen as a functional supplement to traditional media instead of complementary or displacement use. "Although the distinction between interpersonal and mass communication is blurring (e.g. Cathcart and Gumpert 1983), online communication provides the best opportunity for a re-conceptualization of such a 'convergence'

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phenomenon, as it integrates both multimedia and one-on-one communication capabilities (e.g. Kang and Atkin 1999, Lin and Jeffres 1998)" (Lin 2002, 18).

By and large, most of the attraction to distance education is a matter of convenience. To be free of regular class attendance at a specific time and defined place for a given number of weeks is often a sufficient reason for many individuals to study at a distance, especially for adults. Colleges, universities, corporations, government agencies, and the military and health professions are all responsible for the growth of distance education among adult learners.

For all of its popularity and rapid growth, distance education applications of technology have been confronted with serious cautions. The American Federation of Teachers and the National Education Association only reluctantly endorsed technology-based distance education (see chapter 4). A current analysis of instructional technology trends by Molenda and Sullivan (2001) calls distance education (especially Web-based instruction) "still an obsession" with distance education offerings varying greatly by type of institution. Furthermore, "the successful business model is elusive" and for the most part is "not making profits." Molenda and Sullivan continue by reporting that greater successes stem from distance education degree programs "granted by brand-name schools." Consortia are sometimes formed to create a critical mass of distance education courses.

CHAPTER SIX

New Delivery Systems

TREND 6: *New delivery systems have stimulated the development and use of technological applications for teaching and learning. Foremost among them are wireless devices, such as laptop and handheld computers.*

WIRELESS CONNECTIVITY can be described as communication that is handled by computers with no connecting wires or by using smaller, multipurpose devices, such as handheld devices called Personal Digital Assistants or PDAs. Garage door openers and remote controls for television and videotape recorders are two frequently used precursors to the current wave of new wireless computing equipment.

The growth of wireless devices has been ongoing. A good way to begin to capture the essence of this movement is to review the types of devices that are included in the wireless world. The functions that enable universal wireless communication are: terminal mobility, provided by wireless access; personal mobility, based on personal perceived needs; and service portability through use of intelligent network capabilities (Pandya 1999).

Wireless (handheld) technologies include a variety of instruments, such as paging systems, cordless telephones, cellular mobile radio systems, wide area wireless data systems, wireless local area networks, and satellite-based mobile systems (Beaubrun and Pierre 2001). These devices and systems are augmented by other handheld devices used in education settings

such as graphing calculators for mathematics and science and PDAs. Both graphing calculators and PDAs are more powerful, in terms of processor speed and memory, than the first mass-produced personal computers. Some have the capability to connect to the Internet. Inexpensive handheld computers promise to become an increasingly ubiquitous tool for the classroom. The National Council of Teachers of Mathematics (2000) believes that "every student (should have) access to technology to facilitate his or her mathematics learning under the guidance of a skillful teacher" (p. 2). The graphing calculator and handheld computer are the prime candidates.

Syndicated columnist Walter S. Mossberg reviews the past ten years of personal technology developments in a perceptive article published in the *Syracuse (NY) Post-Standard*, 27 October 2001. He reports that, in 1991, there was no sound card in personal computers and modems ran at 2,400 bits per second. The Internet was not yet accessible to average users and the World Wide Web did not exist. The cell phone had limited coverage and was meant for use in cars only. There were no handheld computers that would synchronize with a PC, and digital cameras were just beginning to appear. Digital music players, DVD players, digital camcorders and set-top digital TV recorders didn't exist. He goes on to predict wireless computer developments in which a new world of digital technology will complement wired PCs and other wired digital devices. He believes that the consumer products that will be announced in the next ten years "will have little to do with the personal computer, though they may interact with it" (p. 14) and that Palm Pilot and the wireless networking and phone companies will be the foundations of the next wave of digital equipment. Palm Pilot was introduced in 1996 and now many other companies have released their own version of PDAs. Examples of current use abound. In Orland Park, Illinois, more than 1,700 handheld computers were distributed to students. At Forsyth Country Day School in North Carolina one such device has been given to each of the 850 students. In Wilmington, North Carolina, elementary school students were given PDAs for research purposes.

The rapidly growing use of another wireless device, laptop computers, has been documented in K–12 schools as well as in post-secondary institutions. Improvements in portable (mobile) computing technology and examples of successful pilot programs using laptop computers and other wireless equipment have stimulated acquisition of these devices at home and school (Belanger 2000). Again, examples are plentiful. The College of Education at Wayne State University gave 150 wireless laptops to teacher education students to help teach computer integration skills. Universities participating in the 2001 Campus Computing Project report that wireless services cover about a tenth (10.9%) of the physical campus at those institutions reporting wireless networks (Green 2001).

Laptop computers are integrated into the technology infrastructure of schools and universities in at least five specific ways: (1) each student has his or her own laptop for use at home or in school, (2) a school-purchased classroom set is shared among teachers, (3) in any given classroom, there are students with and without laptops, (4) each classroom is permanently assigned a few laptops for students to share, and (5) some combination of the above models (Rockman et al. 1998).

The spread of mobile computing is still uncertain. Laptops may not become as common as hand-held calculators. Issues of cost, technical support, security and equitable access face schools and colleges that are eager to try these new teaching tools. The research to date has shown learning benefits, especially with respect to increasing student motivation and creating more student-centered classrooms (Belanger 2000).

The Power of the Internet for Learning, written by the Web-based Commission for the President and Congress (2000), states that wireless connectivity is a major trend. There is a growing body of research that suggests that these multipurpose, wireless devices may replace the desktop computer altogether as the primary means to connect to the Internet and other networked resources. Many schools and universities are already on the wireless bandwagon. However, there still needs to be further research, such as that being done at the University of Michigan with their Highly In-

teractive Computing in Education (HI-CE) studies on the effectiveness of middle and high school students using PDAs for field research. Project leader Eliot Soloway has defined a set of software applications that can support the curriculum. Students collect real-time data using probes connected to handheld devices (Fishman et al. 2001).

CHAPTER SEVEN

Professional Development for Teachers

TREND 7: *Opportunities for teachers to become competent in the use of technology for teaching and learning have increased substantially, resulting in greater and improved use in education.*

ALMOST EVERY technological development that has had potential for improving instruction has been confronted with barriers regarding user skill and confidence. Potential users may be convinced that the technology has potential for improving learning but they are reluctant to acquire the skills for using the new technology. Some who promote the use of technology in education, especially marketers who sell products and community lay people, are not aware that training should occur before the innovation can be used with confidence. Many professionals in education, however, know that teachers require training in the operation and use of the new technologies if they are to be competent in their work with students and colleagues. Some educational institutions now set up in-service training for this purpose, and some software and hardware companies now provide training with the sale of their products. In addition, some state and national government agencies have created funding for teacher training in various formats. All of these efforts are aimed at developing a competent staff of curriculum designers and instructors who will be ready to use new hardware and software creatively and effectively in the context of courses they teach. The past decade has seen an increasing number of opportuni-

ties to acquire the necessary knowledge and skills to use instructional design and technology in the delivery of course content.

There is a myth that simply putting computers into schools will directly improve learning. In reality, most teachers haven't received adequate training on how to integrate technology into daily classroom instruction, and technical support is often unavailable or insufficient. Teachers who acquire the knowledge and skills to use technology through subsidized courses and workshops are often rewarded. An article entitled "Internet Access Booms in Schools," published in *USA Today*, 6 September 2001 states, that teachers in the Northwest Independent School District in Dallas, Texas have to master computer skills in order to receive pay raises under a new rule adopted by the school board.

NetDay, a national nonprofit educational technology organization, reported that 84% of teachers believe that computer and access to the Internet improve the quality of education. Seventy-five percent say the Internet is an important tool for finding new resources to meet standards. However, two-thirds of teachers agree that the Internet is not well integrated into their classrooms and only 26% feel pressure to use it in learning activities. Five years ago, few schools had Internet connections and only a handful of classrooms were wired. Today, nearly every teacher has access to the Internet and 80% of classrooms have computers online (NetDay 2001).

In quiet ways, technology has entered the classroom with increasing intensity since the author's 1996 *Trends* was published. The role of educational technology is continuing to evolve as is the equipment employed. The presence of these potentially powerful tools in classrooms continues to encourage inquiry into the nature of learning and ways in which instructors can better assist their students. The pressure to use technology in education by parents and government agencies coupled with the "carrot" of state, federal, and business funding has stimulated growth of technology as a vehicle to reform. Time will determine the extent of adoption and implementation after outside funding has diminished or disappeared. The ultimate evaluation will be the extent to which learners have achieved cur-

riculum goals and objectives. Measures of cost and effectiveness will also inform future commitments to technology in the classroom. It appears, at this point, that technology is an important element in educational reform and will continue to be a major contributor to the change process in schools and universities.

In the summary of a state-by-state survey, Roberts (2001) reports that "Teachers are becoming more proficient with technology and are more at ease in integrating computers into the traditional curriculum . . . . And money for technology for the coming year is at least equal to, if not greater than last year, with a large portion of the funds going to professional development" (p. 52).

CHAPTER EIGHT

Education Reform

TREND 8: *More than ever, reputable organizations perceive the use of instructional technology in schools, colleges and the public sector as a vehicle for education reform.*

AMONG THE MANY CALLS for education reform in the U.S., there are often pronouncements and prescriptions for technology to play a role. Whether it is the use of distance education to handle increased numbers of students in higher education or virtual high schools and universities where computers and the Internet become primary instructional delivery systems, the conclusion appears to be the same. Technology, which has been so prevalent in the larger society, especially in solving business and industrial problems, should be seriously considered for addressing some of the problems that plague America's educational institutions. This approach is humorously stated on a conference button: "Technology Is the Answer! But What Was the Question?" Yes, what is the question? Is it motivation? Is it performance on tests? Is it poor teaching? Or is it all of the above and more? Until each educational program is critically analyzed, it is unlikely that technology by itself will solve anything. So, what are the questions?

During the last century, the introduction of each new technological innovation has brought about enthusiastic advocates. Each new medium was heralded as a revolutionary tool that would change the American edu-

cation system, from the introduction of lantern slides and audio recordings to the motion picture. In 1913, for example, Thomas A. Edison wrote optimistically: "Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years" (Saettler 1968, p. 98).

The introduction in schools of instructional television in the 1950s, programmed instruction in the 1960s, and microcomputers in the late 1970s and early 1980s launched renewed confidence in technology as a vehicle for education reform. A 1993 report by the U.S. Department of Education concluded: "Support for the use of technology to promote fundamental school reform appears to be reaching a new high" (Means et al. 1993, p. 1). This prediction is even more appropriate today.

The 1996 edition of *Trends in Educational Technology* (Ely) points to the establishment of six Regional Technology Centers in 1995 by the U.S. Department of Education. In 2000, a realignment of the R*TECs (as they were called) created ten centers. Each one was established to help states, districts, schools, adult literacy centers and other institutions to use advanced technology to support teaching and learning. When the centers were realigned, every state education department either had a technology plan or was in the process of preparing one (Hezel 1999). By early 2002, every state had a technology plan for education.

Much of the leadership in the applications of technology to teaching and learning came from the U.S. Department of Education. In the report entitled *The Secretary's Conference on Educational Technology 2000: Measuring the Impacts and Shaping the Future*, a concluding statement put forth two basic premises: "No longer asking *if* technology should be part of the educational processes, the question has now shifted to *what* constitutes an excellent education in this digital age, and *how* schools use technology effectively to advance student learning" (Secretary's Conference 2000, p. 64).

In a recent survey of post-secondary educators by the United Univer-

sity Professions (2001), 60% of the instructors surveyed said they would be willing to try teaching online even though 90% said that they had never done it. That the instructors in these institutions of higher education are willing to attempt to integrate technology into their instruction indicates a swing toward greater acceptance socially and culturally of technology in education.

Appendix

List of 1996 and Current Trends

Each trend published in the 1996 edition of this book is listed first. Each current, related trend follows in italics.

TREND 1

Computers are pervasive in school and higher education institutions. Virtually every student in a formal education setting has access to a computer.

There is near saturation of computers in K-12 schools, while higher education institutions report moderate saturation. Students and teachers have almost universal access to computers, many of which are connected to the Internet.

TREND 2

Networking is one of the fastest growing applications of technology in education.

The Internet has become a major source of information for students and teachers. In higher education, the use of the Internet to deliver instruction has been steadily growing.

TREND 3

Access to television resources in the schools is almost universal.

Video materials are increasingly being delivered by a variety of distribution systems, such as video streaming on the Web, video conferencing, synchronous teaching and learning by closed circuit, broadcast and satellite television systems. Use of video in classrooms and independent study spaces has leveled off.

TREND 4

Advocacy for educational technology has increased among policy groups.

More community organizations than ever are promoting and supporting the use of technology for teaching and learning in schools, colleges and the public sector. Policy organizations have joined the chorus of voices that advocate more and better use of technology in schools and higher education.

TREND 5

Educational technology is increasingly available in homes and community settings.

The home has become a classroom for children and adults. Distance education has become a significant provider of instruction through the use of technological media.

TREND 6

New delivery systems for educational technology applications have grown in geometric proportions.

New delivery systems have stimulated the development and use of technological applications for teaching and learning. Foremost among them are wireless devices, such as laptop and handheld computers.

TREND 7

There is a new insistence that teachers must become technologically literate.

Opportunities for teachers to become competent in the use of technology for teaching and learning have increased substantially, resulting in greater and improved use in education.

TREND 8

Educational technology is perceived as a major vehicle in the movement toward education reform.

More than ever, reputable organizations perceive the use of instructional technology in schools, colleges and the public sector as a vehicle for education reform.

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